RADIATION PHYSICS NOTE #13

RELATIVISTIC RISE IN dE/dX FOR Cu

Craig Moore

November 30, 1976

We will compare a measurement of dE/dX in Cu made during the course of Experiment E-108 with the dE/dX predicted by Sternheimer[1]. Sternheimer has given an expression which yields dE/dX as a function of incident particle type, incident particle momentum and target material. The expression is:

$$\frac{1}{\rho}\frac{dE}{dX} = \frac{A}{\beta^2}\left[B + .69 + 2\ln\frac{P}{\mu c} + \ln T - 2\beta^2 - \delta\right]$$

where, A,B are material dependent constants

P = incident particle momentum

μ = incident particle mass

β = incident particle velocity in units of speed of light

T = the maximum energy transfer in a single collision in MeV

δ = density effect correction

Putting in the appropriate values for 300 GeV/c protons on a Cu detector we obtain:

$$\frac{1}{\rho}\frac{dE}{dX} = 2.05\ \frac{MeV}{g/cm^2}$$

The experimental measurement was performed by placing a 1/8" thick Cu slug (1" diameter) in a beam of 300 GeV protons

[1] R. M. Sternheimer PR 103 511.

and measuring the temperature rise. Using the raw SEM counts we obtained a value of 2.19 MeV/g/cm^2. (Using a correction for the SEM obtained from a foil activation measurement we obtain dE/dX = 1.95 MeV/g/cm^2.) Hence to within the accuracy of the experiment, the predicted and experimental results are in agreement.

CM/jo